

REMARKS

Claims in the case are 10-14, upon entry of this amendment. Claim 10 has been amended, no claims have been added, and no claims have been cancelled herein.

Claim 10 has been amended herein such that it now has closed-end transitional language.

Claims 10-14 stand rejected under 35 U.S.C. 103(a) as being unpatentable over F.C. Nava Alonso et al, *Tungsten Trioxide Reduction-Carburization with Carbon monoxide – Carbon Dioxide Mixtures: Kinetics and Thermodynamics*, INTERNATIONAL JOURNAL OF MINERAL PROCESSING, 20 (1987), pp 137-151 (**Alonso et al**) in view of United States Patent No. 4,851,041 (**Polizzotti et al**) and Demande de Brevet D'Invention N° de publication 2 294 133 (**Felten et al**). This rejection is respectfully traversed in light of the amendments herein and the following remarks.

Polizzotti et al disclose a method of preparing composite articles that include: a metal matrix (e.g., of cobalt); and a refractory metal compound (e.g., tungsten carbide). See the abstract, and column 2, line 28 through column 3, line 6 of Polizzotti et al. The method of Polizzotti et al involves: providing a precursor compound that contains at least one metal, e.g., an organometallic compound such as $\text{Co(en)}_3\text{WO}_4$; heating the precursor compound to remove the ligand; and optionally reacting at least one of the metals. Polizzotti et al disclose a carburization process that is necessarily performed in the presence of both a matrix forming metal precursor (e.g., Co(en)_3) and a precursor to a refractory metal compound (e.g., WO_4). See column 2, lines 46-57, and column 6, lines 6-10 of Polizzotti et al.

Applicants respectfully submit that the disclosure of Polizzotti et al as to the effect of carbon activity on product formation is limited to a carburization temperature of 1400K (1127°C). See Figures 1 and 2 of Polizzotti et al. Applicants' claimed method involves a carburization temperature of from 850°C to 950°C. As such, Polizzotti et al's disclosure regarding the effect that carbon activity may have on product formation does not reasonably extend to or otherwise touch upon the process of Applicants' present claims.

On page 3 of the Office Action of 4 October 2005, it is argued with reference to Figure 2 of Polizzotti et al that cobalt does not participate in the carburization process at Applicants' claimed carbon activity range. As discussed previously herein, the disclosure of Polizzotti et al as to the carburization process in this regard is limited to a process temperature of 1400K (1127°C). Since Applicants' claimed method involves a carburization temperature of from 850°C to 950°C, Polizzotti et al's disclosure as to whether cobalt participates or not does not reasonably extend to or touch upon Applicants' present claims.

On pages 4-5 of the Office Action of 4 October 2005, it is argued that Applicants' comparative data (provided in a Declaration with their Amendment dated 13 September 2005) does not evidence unexpected results with regard to carbon activities of less than 0.4. Applicants respectfully disagree, and submit that their comparative data clearly shows that **under the same reaction conditions**, carbon activity values of less than 0.4 result in the formation of a tungsten carbide product that contains undesirable contaminants, relative to carbon activity values of 0.4 or greater (and less than 1.0).

On page 5 of the Office Action of 4 October 2005, it is remarked that Applicants' comparative data "merely [shows] that the reaction takes longer." Applicants' respectfully counter that in addition to providing a tungsten carbide product that contains undesirable contaminants (as discussed previously herein), carbon activity values of less than 0.4 also result in a reaction having an undesirably low reaction rate. An undesirably low reaction rate, with regard to a comparative process conducted under the same conditions as an inventive process, is not a mere annoyance or inconvenience, but rather a substantial result which clearly evidences an unexpected result, as would be recognized by a skilled artisan.

For purposes of thoroughness, a discussion of the comparative data previously submitted in the Declaration included with Applicants' previous Amendment of 13 September 2005 is provided as follows. Comparative Examples 1, 2 and 3 of the previously submitted Declaration were conducted under the same conditions as described in Example 1 of the specification (page 8). Example 1 of the specification was performed with a carbon activity of 0.65 (within Applicants' claimed range of "from 0.4 to less than 1"), while Comparative Examples 1-3 of the

Declaration were performed with carbon activities of 0.35, 1.11 and 1.03, which are outside of Applicants' claimed range. The material produced according to Example 1 was found, by x-ray diffraction analysis, to be pure-phase tungsten carbide. The materials produced according to Comparative Examples 1, 2 and 3 each undesirably contained unconverted tungsten (i.e., they were not in the form of pure-phase tungsten carbide).

Alonso et al disclose a method of preparing tungsten carbide by heating tungsten trioxide in the presence of (i) mixtures of CO and CO₂, and (ii) CO alone, at temperatures from 700°C to 1000°C (abstract). Alonso et al teach that "[t]he rate and extent of reaction of tungsten trioxide reduction-carburization decreases as the carbon dioxide content in the CO-CO₂ mixture increases" (page 150, item-3).

Alonso et al further teach that the most appropriate conditions for the reduction-carburization of tungsten trioxide involves the use of a gas consisting of 100% CO (page 150, item-1). As such, when taken as a whole, a skilled artisan would reasonably interpret Alonso et al as teaching away from the use of mixtures of CO and CO₂ in favor of CO alone for the carburization of tungsten trioxide.

Applicants submit that when CO is used alone for the carburization of tungsten trioxide, the undesirable deposition of elementary carbon is thermodynamically possible in later stages of the reaction, due to the reaction of CO with W or WO₂. Alonso et al appear to disregard the resultant deposition of elementary carbon in their process. Carbon deposition in later stages of the carburization reaction competes with and reduces the desired formation of WC.

With reference to Figure 10 at page 147 of Alonso et al, there are disclosed reaction rates for the reduction-carburization of WO₃, at a temperature of 900°C, as a function of the amount of CO present in the CO-CO₂ mixtures, which clearly shows that the reduction rate increases with increasing amounts of CO. Applicants further submit that using published thermodynamic information, the carbon activity associated with the equilibrium point of W₂C and WC at a temperature of 900°C is calculated as being 0.08, and corresponds to 20% CO₂ / 80% CO. For the formation of WC to occur, this equilibrium carbon activity of 0.08 (which corresponds to 20% CO₂ / 80% CO) must be either met or exceeded. Alonso et al only disclose carbon activities that are either below this equilibrium point (i.e., 78% and 61% CO), or at

infinity (i.e., 100% CO). As discussed previously herein, the undesirable formation of carbon black residue at 100% CO, renders such a CO level effectively inoperable. As such, Alonso et al does not disclose, teach or suggest carbon activities that result in the formation of WC (in the absence of carbon black formation).

Applicants have found that minimizing the deposition of carbon in the course of the carburization of tungsten trioxide requires that the carbon activity be less than 1, but at the same time not so low as to render the rate of WC formation negligible. Alonso et al do not disclose, teach or suggest the selection of a carbon activity that will result in a combination of: (i) minimum carbon deposition; coupled with (ii) a desirable rate of WC formation.

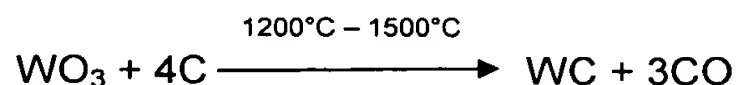
Contrary to the assertions made on page 3 of the Office Action of 4 October 2005, Applicants respectfully submit that Alonso et al does not disclose or suggest Applicants' claimed range of carbon activity values of 0.4 to less than 1. It is argued on page 3 of the Office Action that Alonso et al discloses a broad range of carbon activity values ranging from 0.026 (61 wt% CO) to essentially infinity (100 wt% CO); based on the disclosure at page 145 of Alonso et al. Applicants disagree and respectfully submit that this argument represents a mischaracterization of Alonso et al. Alonso et al's disclosure of carbon activity values of essentially infinity is for a gas that consists of 100 wt% CO (i.e., a gas that is free of CO₂). Applicants' claimed method involves the use of a mixture of CO and CO₂. As such, Alonso et al's disclosure relating to a gas consisting of 100% CO, and any carbon activity values associated therewith or derived therefrom does not reasonably extend to or touch upon Applicants' claimed process and carbon activity range of 0.4 to less than 1.

Alonso et al's highest disclosed carbon activity value for a mixture of CO and CO₂ is 0.077 (78 Wt% CO), which is 5.2 times smaller than the lower limit of Applicants' claimed carbon activity range of 0.4 to less than 1. As such, Alonso et al's disclosure is not deemed to reasonably extend to, touch upon or suggest Applicants' claimed method, which recites a carbon activity value range of 0.4 to less than 1.

Felton et al disclose a method of preparing tungsten carbide that involves treating finely divided tungsten trioxide with carbon monoxide (CO) at a temperature

at which no agglomeration or sintering occurs (e.g., at temperatures of 600°C, 700°C and 800°C). See the abstract, and the examples at page 5-6 of Felton et al.

At page 1, line 23, Felton et al disclose the following formula.



This disclosure by Felton et al is limited to the formation of tungsten carbide from tungsten trioxide, and does not reasonable extend to or touch upon a post heat treatment of tungsten carbide after it is formed.

On page 4 of the Office Action of 4 October 2005, it is argued that a skilled artisan would be motivated to apply Felton et al to Alonso et al so as to "ensure that any remaining unreacted precursor WO_3 after the process of Alonso et al would have been converted to WC" (emphasis added). Since Alonso et al provide no disclosure or suggestion as to the presence of unreacted precursor tungsten oxide, it is respectfully submitted that the argument provided on page 4 of the Office Action evidences an assumption on the part of the proponent thereof.

The remarks on page 4 of the Office Action regarding the disclosure by Felton et al representing a post heat treatment of tungsten carbide after it is formed, and those further remarks provided on page 4 of the Office Action, are deemed to represent an assumption on the part of the Examiner that is neither supported nor suggested by the disclosures of Felton et al or Alonso et al. "[E]xaminer's assumptions do not constitute the disclosure of prior art." *In re Rijckaert*, 9 F.3d 1531, 1533, 28 U.S.P.Q.2d 1955, 1956 (Fed. Cir. 1993)

Alonso et al disclose a method of preparing tungsten carbide that involves heating tungsten trioxide in the presence of Co and CO_2 mixtures, or CO alone. Alonzo et al provide no disclosure, teaching or suggestion with regard to heating tungsten trioxide in the presence of a separate matrix forming metal, such as cobalt. The process disclosed by Polizzotti et al necessarily involves performing carburization in the presence of a matrix forming metal (e.g., cobalt). Polizzotti et al provide no disclosure, teaching or suggestion as to the carburization of tungsten trioxide. As such, neither Alonso et al nor Polizzotti et al provide the requisite disclosure that would motivate a skilled artisan to combine or otherwise modify their disclosures to arrive at Applicants' presently claimed process.

Felton et al disclose treating tungsten trioxide with carbon monoxide. Felton et al provide no disclosure, teaching or suggestion with regard to performing such a reaction in the presence of a matrix forming metal, such as cobalt. The process disclosed by Polizzotti et al necessarily involves performing carburization in the presence of a matrix forming metal (e.g., cobalt). Polizzotti et al provide no disclosure, teaching or suggestion as to the carburization of tungsten trioxide. As such, neither Felton et al nor Polizzotti et al provide the requisite disclosure that would motivate a skilled artisan to combine or otherwise modify their disclosures to arrive at Applicants' presently claimed process.

Even if Alonso et al, Polizzotti et al and Felton et al were combined, Applicants' claimed method would not result from such combination. Alonso et al teach away from tungsten trioxide carburization methods that make use of mixtures of CO₂ and CO in favor of those that make use of CO alone. Alonso et al do not disclose, teach or suggest a range of carbon activity values that overlap or even come close to Applicants' claimed range of 0.4 to less than 1. Alonso et al provide no disclosure or suggestion with regard to post treating tungsten carbide at an elevated temperature of 1150°C to 1800°C after the tungsten carbide is formed. Polizzotti et al's disclose as to carburization process is limited to: (i) an operating temperature of 1400K (1127°C); and (ii) being performed in the presence of a matrix forming metal, such as cobalt. Felton et al disclose the formation of tungsten carbide from tungsten trioxide by heating in the presence of CO alone. Felton et al provide no disclosure, teaching or suggestion with regard to performing their disclosed reaction with a mixture of CO and CO₂. Felton et al provide no disclosure, teaching or suggestion with regard to: carbon activity values of 0.4 to less than 1; or post treating tungsten carbide at an elevated temperature of 1150°C to 1800°C after the tungsten carbide is formed.

Alonso et al, Polizzotti et al and Felton et al, either alone or in combination, do not disclose, teach or suggest a carburization method that consists of: the use of a mixture of CO and CO₂; the CO₂ being present in an amount above the Boudouard equilibrium content corresponding to the carburization temperature; a temperature of 850°C to 950°C; a carbon activity of from 0.4 to less than 1; and a post treatment step that involves heating the formed tungsten carbide to a temperature of 1150°C

to 1800°C. In addition, Alonso et al, Polizzotti et al and Felton et al, either alone or in combination, do not disclose, teach or suggest the superior results obtained with the carburization method of Applicants' present claims, as discussed previously herein with regard to the comparative results previously provided in the declaration along with Applicants' Amendment dated 13 September 2005.

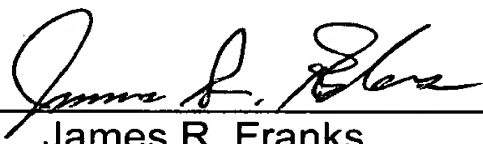
In light of the preceding remarks, Applicants respectfully submit that a *prima facie* case of obviousness has not been made relative to Alonso et al, Polizzotti et al and Felton et al, either alone or in combination. "[T]he examiner bears the initial burden of presenting a *prima facie* case of obviousness. Only if that burden is met, does the burden of coming forward with evidence or argument shift to the Applicants." *In re Rijckaert*, 9 F.3d 1531, 1532 (Fed. Cir. 1993). It is submitted, *in arguendo*, that even if a *prima facie* case of obviousness has been made relative to the cited references, Applicants have met their burden of coming forward with evidence that clearly rebuts any inference of obviousness relative to, and supports the non-obviousness of, their claimed process (in particular with regard to their claimed carbon activity range of from 0.4 to less than 1).

The rejection appears to impermissibly use Applicants' application as a blueprint for selecting and combining or modifying the cited references to arrive at Applicants' claimed invention, thereby making use of prohibited hindsight in the selection and application of the cited references. The use of hindsight reconstruction of an invention is an inappropriate process by which to determine patentability. *In re Rouffet*, 47 U.S.P.Q.2d 1453, 1457 (Fed. Cir. 1998). One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art to deprecate the claimed invention. *In re Fine*, 837 F.2d 1071, 1075 (Fed. Cir. 1988). Modifying "prior art references without evidence of such a suggestion, teaching or motivation simply takes the inventor's disclosure as a blueprint for piecing together the prior art to defeat patentability -- the essence of hindsight." *In re Dembiczak*, 175 F.3d 994, 999 (Fed. Cir. 1999). "The mere fact that the prior art may be modified in the manner suggested by the Examiner does not make the modification obvious unless the prior art suggested the desirability of the modification." *In re Fritch*, 972 F.2d 1260, 1266 (Fed. Cir. 1992).

In light of the preceding remarks, Applicants' claims are deemed to be unobvious and patentable over Alonso et al in view of Polizzotti et al and Felten et al. Reconsideration and withdrawal of the present rejection is respectfully requested.

In light of the amendments herein and the preceding remarks, Applicants' presently pending claims are deemed to define an invention that is unanticipated, unobvious and hence, patentable. Reconsideration of the rejections and allowance of all of the presently pending claims is respectfully requested.

Respectfully submitted,

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